

Telemedicine evaluation of new head and neck patients at a tertiary academic clinic during the coronavirus disease 2019 pandemic

Journal of Telemedicine and Telecare
1–11
© The Author(s) 2022
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: [10.1177/1357633X221100054](https://doi.org/10.1177/1357633X221100054)
[journals.sagepub.com/home/jtt](http://jtt.sagepub.com/home/jtt)



Katherine Z Xie¹ , Luis A Antezana¹ , Andrew J Bowen², Linda X Yin², Sarah Yeakel², Ashley Nassiri², and Eric J Moore²

Abstract

Introduction: Coronavirus disease 2019 accelerated the use of virtual visits within health care. We examined the utility of telemedicine for conducting visits in a tertiary head and neck practice.

Methods: A retrospective study was conducted on patients presenting via video to a tertiary-level head and neck clinic between January 2020 and December 2020. Patient demographics were collected in addition to visit indication, diagnostic imaging/tests at the time of visit, and post-visit plan. Visits were deemed successful if evaluation by video was sufficient in determining a clinical plan and did not require deferral of recommendations for subsequent in-person consult visits and/or work-up (labs, imaging). Logistic regression was performed to identify variables that served as significant predictors of successful video visits.

Results: A total of 124 video visits were reviewed. Video visits were successful for the initial evaluation 88.7% of the time ($n = 110$). Computerized tomographic scans were the most available diagnostic test, available for 54% of patients ($n = 67$), followed by biopsy report 30.6% ($n = 38$). Visit indication had a statistically significant effect on whether a treatment plan could be made ($p = 0.024$). For new patients with parotid masses ($n = 42$), definitive treatment plans could be made 97.6% of the time ($n = 41$). Patients presenting with an indication of thyroid mass (odds ratio: 0.19 (confidence interval: 0.00072–0.50), $p = 0.018$) and other neck mass (odds ratio: 0.035 (confidence interval: 0.0014, 0.90), $p = 0.043$) were at significantly lesser odds than parotid patients to have a successful video visit.

Discussion: In this study, virtual visits were successful for a high percentage of head and neck visits, particularly among patients seeking evaluation for parotid-related concerns.

Keywords

Otolaryngology, telemedicine, telehealth, COVID-19, pandemic

Date received: 31 January 2022; Date accepted: 23 April 2022

Introduction

Telemedicine within otolaryngology has been explored for over 30 years.^{1–3} Previous studies suggest that the modality is well suited for this specialty given the difficulty for rural communities to access otolaryngology care, in addition to the ability for otolaryngologists to determine the need for in-person visitation from a virtual consultation and frequently make diagnoses based on objective imaging findings.^{2,4–14}

Stay-at-home orders and changes in insurance reimbursement for virtual visits alongside relaxation of state licensure limitations implemented during the early coronavirus disease 2019 (COVID-19) pandemic catalyzed the development of telemedicine proposals.^{15,16} Video visits

enable otolaryngologists to provide essential patient care while minimizing viral exposure, especially in the context of the high risk of exposure to the high viral loads associated with head and neck examination.^{17–20}

Historically, the use of telemedicine has not affected overall mortality nor clinical effectiveness in various

¹Mayo Clinic Alix School of Medicine, Mayo Clinic, Rochester, MN, USA

²Department of Otolaryngology (ENT)/Head and Neck Surgery, Mayo Clinic, Rochester, MN, USA

Corresponding author:

Eric J Moore, Department of Otolaryngology (ENT)/Head and Neck Surgery, Mayo Clinic, 200 1st St SW, Rochester, MN 55905, USA.
Email: moore.eric@mayo.edu

specialties.^{21,22} Limited studies exist to assess the suitability of telemedicine for synchronous patient encounters.¹³ We examine whether the video platform can be utilized by tertiary-care otolaryngologists to evaluate and make definitive treatment plans for new head and neck patients. Our secondary goals are to assess what variables (eg, visit indication and available work-up) significantly affect the success of video visits. We hypothesize that use of a telemedicine platform alongside pre-consultation work-up will enable otolaryngologists at tertiary-care centers to successfully make clinical recommendations for a subset of patients without an in-person consultation.

Methods

Patient selection

This was a retrospective review of new patients presenting via video to a tertiary academic, multiple-surgeon otolaryngology clinic during the first year of the COVID-19 pandemic. The study was deemed Institutional Review Board (IRB) exempt by the Mayo Clinic (IRB 20-011853). A list of all new patients who underwent video visits with a staff otolaryngologist within the head and neck division of our department between January 2020 and December 2020 was generated from the electronic medical record (Figure 1). All video visits included were conducted via HIPAA-compliant Zoom Version 5.6.6 (Zoom Video Communications Inc; San Jose, CA).

Data collection

The primary outcome was the result of the video visit, designated as successful or unsuccessful. In this study, a video visit was defined to be successful by our team if the physician was able to develop a definitive treatment plan using history, examination, and available work-up assessed during the video visit. Conversely, a video visit was considered unsuccessful if the physician explicitly documented the need for further in-person evaluation or work-up (e.g. labs, tests, imaging, and consults) to be able to make a definitive treatment plan that was surgical, medical, or observational in nature.

Visit indication, relevant imaging, and lab and pathology reports obtained within 1 year of the video visit and available to the physician were also noted. The definitive treatment plans proposed were recorded in cases of successful visits and then any follow-up recommended for patients in cases of unsuccessful visits. Follow-up visits occurring outside of a direct surgical or clinic visit within our department were categorized as “other” and included visits such as consults to other departments (Table 1).

Statistical analysis

JMP Version 16.0.0. (SAS Institute Inc.; Cary, NC) was used for all analysis. Descriptive statistics including mean

and standard deviation were used to characterize cohort demographics, the success of video visits, available work-up, and post-visit recommendations (Table 1). An unpaired two-tailed *t*-test ($\alpha=0.05$) compared the mean number of diagnostic tests available for patients who had successful versus unsuccessful video visits.

Logistic regression analysis was performed to evaluate the effect of patient and visit factors on the ability to make a treatment plan. Visit indications were categorized into 8 groups based on underlying pathology for further analysis, modeled off of categorizations in a previous otolaryngology telemedicine study²: (a) parotid mass; (b) oral cavity/oropharynx neoplasm; (c) larynx/pharynx; (d) thyroid nodule/mass; (e) neurogenic pathologies including schwannoma and paraganglioma; (f) other neck mass including lipoma, metastatic carcinomas, cysts, enlarged lymph nodes; (g) eyelid/lacrimal duct neoplasm; or (h) miscellaneous (e.g. squamous cell carcinoma of the scalp, facial paralysis, dysphagia, etc.). Univariate and adjusted multivariate logistic analyses were performed to determine whether the visit indication, number and types of diagnostic tests, patient age, and/or patient sex impacted virtual visit success. For an analysis by indication, parotid mass was used as the reference for comparison given the near 100% rate of success of establishing a treatment plan through a video visit. The reference group for analysis based on the number of diagnostic tests was set to 2, the median number available in patients for which a treatment plan could be made.

Heat maps

Heat maps depicting patient catchment were generated using Tableau Version 2020.4.1 (Tableau Software, LLC; Seattle, WA). In-person and virtual visit zip code data were pulled from the electronic medical record. US population densities by zip code were acquired from the US Census Bureau.²³

Results

Overview of examined video visits

Between January 2020 and December 2020, 313 video visits were conducted in the head and neck department at our institution. Of the 313, 124 were “new” ($n=86$) or “consult” ($n=38$) visits involving with new unaddressed otolaryngological concerns (Figure 1). The number of visits by month is shown in Figure 2.

Cohort demographics

The cohort was 50.8% female ($n=62$, average age: 54 years). The median distance in miles between a patients’ home zip and our institution was 365, interquartile range (IQR) 734

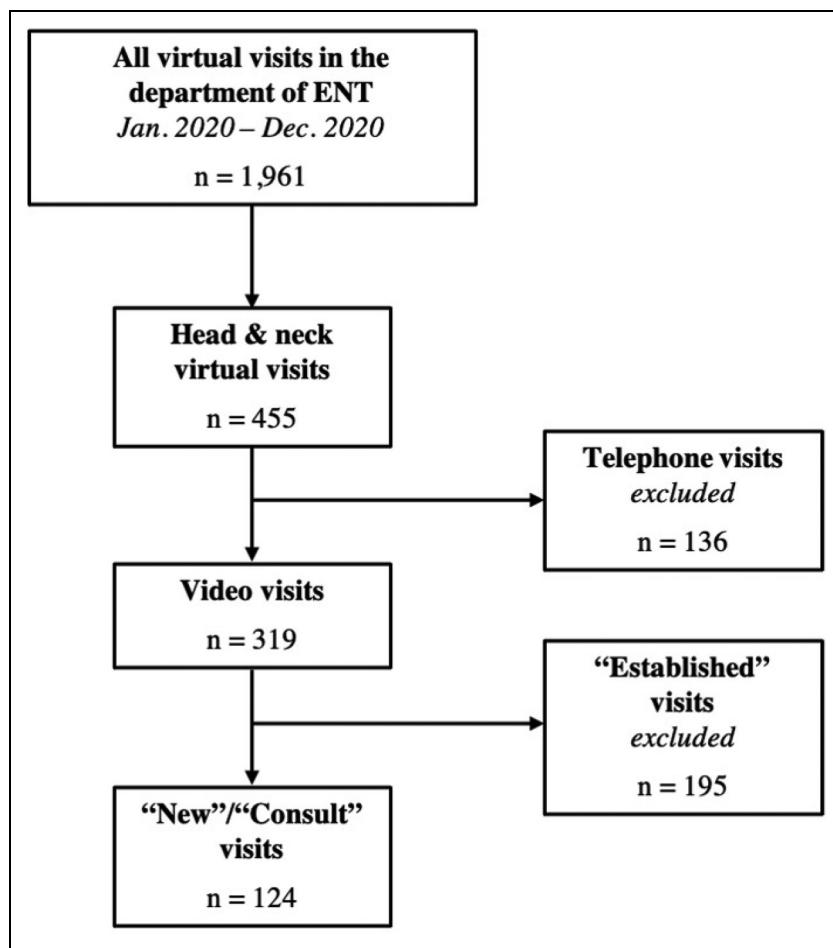


Figure 1. Patient selection flowchart. “New” visits encompassed self-referred patients or patients referred from outside medical physicians and “consult” visits were comprised of new patients referred from within our institution’s health system.

(195–930) (Table 1). According to Figure 3, the overall distribution of video visit patients was geographically representative of the corresponding in-person visits from the year prior. In addition, there appeared to be an increased proportion of patients living outside the Midwest region evaluated by video visits in comparison to the prior year of in-person visits.

Descriptive statistic characterization of success of video visit based on visit indication

The most common indication for seeking treatment was parotid mass ($n=42$, 34%), followed by lesions of the oral cavity/oropharynx ($n=28$, 23%). Together, these comprised over half of all visits (Figure 4). Evaluation by video visit alone was successful for most patients ($n=110$, 89%), with only 11% ($n=14$) of patients requiring an accompanying in-person visit to obtain additional physical examination, imaging, biopsy, or consultation with other departments for initial evaluation. Nearly all patients presenting with a parotid mass ($n=42$) had a successful video visit and obtained a definitive treatment plan ($n=41$, 98%) usually

involving surgery ($n=26$, 63.4%) following the video visit evaluation alone (Table 1).

Characterization of diagnostic tests available at the time of video visit

The most common diagnostic tests were computerized tomographic (CT) scans, available for 54% ($n=67$) of patients, followed by biopsy reports ($n=38$, 30.6%) and magnetic resonance imaging (MRI) ($n=34$, 28%) (Table 1). No significant difference was observed in the mean number of diagnostic tests available for successful video visits (1.56, SD: 1.03) and unsuccessful video visits (1.17, SD: 0.83) ($p=0.18$) (Table 1).

Logistic regression analysis for successful video visit—visit indication, diagnostic test, age, and sex

The type of diagnostic test available, patient age, and patient sex were not statistically significant predictors of a

Table 1. Baseline characteristics of patients.

	All patients	Parotid patients
Total visits	124	42
Total patients	122	42
Distance from institution to home zip (miles), number (%)		
0–50	9 (7.4%)	-
50–250	33 (27.0%)	-
250–500	25 (20.5%)	-
500–1000	29 (23.8%)	-
1000 +	26 (21.3%)	-
Distance from institution to home zip code (in miles)		
Mean (SD)	548 (544)	-
Median (IQR)	365 (734; 195–930)	-
International, number (%)	12 (9.8%)	-
Sex, number (%)		
Male	60 (49.2%)	18 (42.9%)
Female	62 (50.8%)	24 (57.1%)
Age, mean (SD)	54.4 (16.8)	46.5 (14.3)
Success of virtual visit, number (%)		
Successful evaluation by virtual visit alone	110 (88.7%)	41 (97.6%)
Additional in-person evaluation needed	14 (11.3%)	1 (2.4%)
Plan after successful video visit evaluation		
Follow up as needed, number (%)	13 (11.8%)	4 (9.8%)
Follow up recommended, number (%)	97 (88.2%)	37 (90.2%)
Surgery	62 (63.9%)	26 (70.3%)
Clinic	22 (22.7%)	9 (24.3%)
Other	13 (13.4%)	2 (5.4%)
Number of diagnostic tests per patient, mean (SD)		
Treatment plan made	1.56 (1.03)	1.55 (1.04)
Additional follow up needed	1.17 (0.83)	
Type of diagnostic test, number (%)		
MRI	34 (27.4%)	16 (38.1%)
CT	67 (54.0%)	19 (45.2%)
PET	26 (21.0%)	3 (7.1%)
Biopsy	38 (30.6%)	10 (23.8%)
Ultrasound	23 (18.5%)	9 (21.4%)

Distance between patient's home and our institution was calculated as the distance between the center latitude and longitude point of each zip code. IQR: interquartile range; MRI: magnetic resonance imaging; CT: computerized tomography; PET: positron emission tomography.

successful video visit in either the univariate crude or multivariate-adjusted models (Table 2). However, visit indication was a significant predictor in both models. Specifically, patients presenting with an indication of thyroid mass (odds ratio (OR): 0.19, confidence interval (CI): 0.00072–0.50; $p=0.018$) and other neck mass (OR: 0.035, CI: 0.0014–0.90; $p=0.043$) were at significantly lesser odds than parotid patients to have a successful treatment plan made from video evaluation (Table 2, Figure 5). While patients presenting with an indication of oral cavity/oropharynx mass were not at overall lesser odds of having a successful video visit, there was a high proportion of unsuccessful video visits and subsequent in-person evaluation ($n=3$, 42.8%) for patients with tonsillar neoplasms ($n=7$), a subgroup of oral cavity/oropharynx masses.

Recommendations following the initial video visit

For those who had a successful video visit ($n=110$), surgery was the most common recommendation ($n=62$, 56.4%) followed by routine surveillance ($n=22$, 20.0%) (Table 1). Of the 62 patients who were offered surgery as one potential treatment option, 64.5% ($n=40$) had elected to undergo surgery at our institution at the time of review, with all surgeries being the procedure initially discussed during the video consult or otherwise discussed as a possibility to proceed with if indicated. Of those who did not elect to undergo surgery at our institution, most frequently patients had been seeking a second opinion and pursued definitive care locally ($n=13$). Patients not having a treatment plan made successfully via video visit ($n=14$, 11.3%) were advised to schedule an in-person follow-up

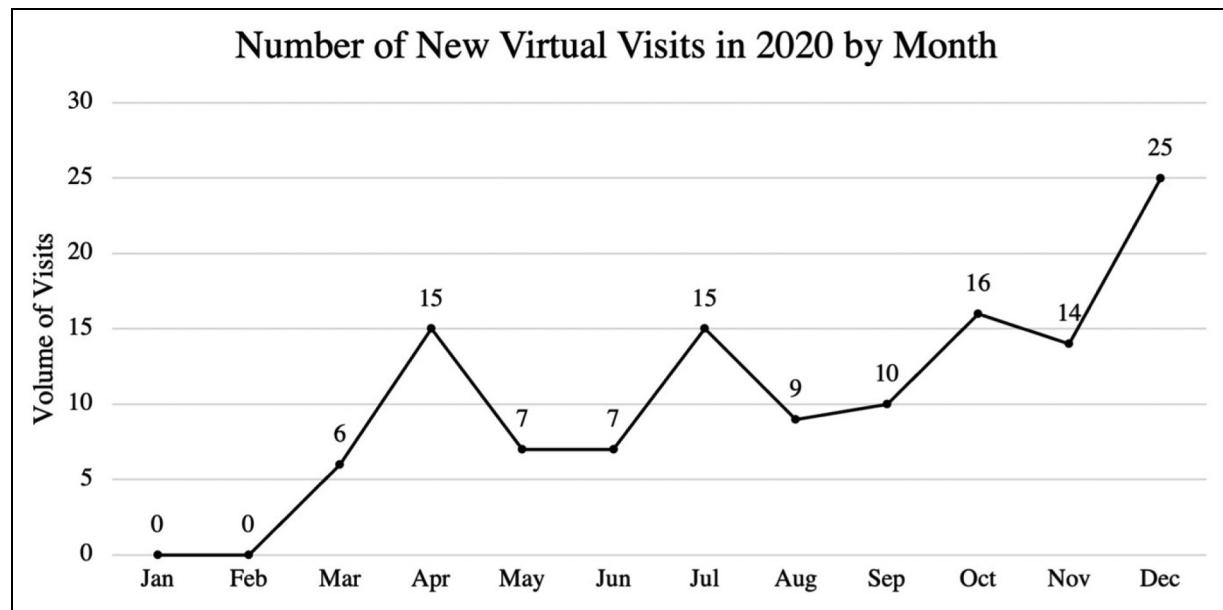


Figure 2. Number of new patients seen by video visit in 2020 by month.

for biopsy, lymphoma staging work-up, physical examination, and/or additional imaging.

Discussion

Overview

The COVID-19 pandemic ushered in the rapid implementation of telemedicine as a means of maintaining essential health services across the United States. Notably, special considerations are required for the successful and sustained integration of tele-health with a health system. To the best of our knowledge, implementation at our institution address such considerations (e.g. adequate personnel training, accreditation for professionals, funding for day-to-day infrastructure, etc.).^{24,25}

The volume of video visits initially spiked in March and April 2020 coinciding with the onset of early nationwide stay-at-home orders (Figure 2).^{16,26} During this time, insurance companies also increased compensation for video visits and changes in federal malpractice laws allowed physicians to practice across state lines.^{27,28} Notably, the volume of video visits continued to grow over the ensuing months (Figure 2).¹⁶ Possible explanations include the continued recommendations to avoid non-essential travel, the roll-out of vaccinations, and the continued insurance reimbursement of video visits.²⁹⁻³¹ This may have also reflected increasing comfort of staff and patients with using video visits in developing rapport, obtaining the history, reviewing images, and performing an auditory and visual assessment of physical appearance, voice-airway symptoms, and wound-lesion evaluations. Many studies have examined patient and physician satisfaction within the head and neck specialty.^{2,32-40} Shehan et al. recently evaluated changes in

demographic and outpatient otolaryngology visit characteristics, such as the number of tests ordered and medications prescribed pre- and during COVID.⁴¹ However, there remains limited literature surrounding the ability to form treatment plans reflective of in-person evaluations for head and neck pathologies.⁴² Our study aims to assess the utility of video evaluation to recommend a treatment plan for new patients within the head and neck division at a tertiary-care practice.

Visit indications more amenable to evaluation by video visit

Evaluation by video visit appears to be particularly useful for patients with parotid pathologies, as all but one patient received a definitive treatment plan from a single visit. For these patients, surgery was most recommended followed by serial imaging for observation of tumor progression. The high ability to provide definitive treatment plans for parotid masses may result from the reliance on objective imaging which is generally available for patients presenting to a tertiary care center as well as the largely unimodal treatment—surgical intervention regardless of benign versus malignant pathology.⁴³ For example, our study finds that while fine-needle aspiration demonstrates a high accuracy in differentiating between benign and malignant, a plan involving surgery could be made even in its absence. Furthermore, parotid pathology suggesting a malignant process generally stems from clinical history (pain, palpable lymphadenopathy, new-onset paresthesia, and facial nerve paresis/paralysis), easily obtained during a video visit.⁴³ In this study, all parotid masses were found to be primary tumors. However, parotid masses may also serve as initial metastatic

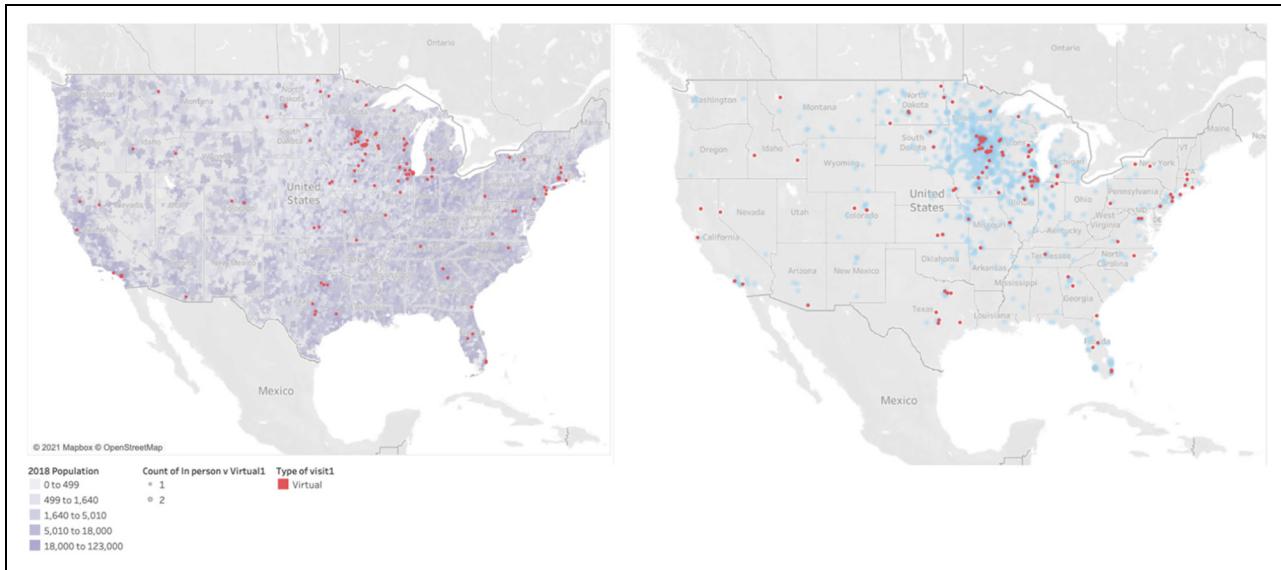


Figure 3. Left: head and neck video visits (red dots) superimposed on population density underlay (purple). Right: Head and neck video visits (red dots) superimposed on all department in-person visits in 2019 (blue dots).

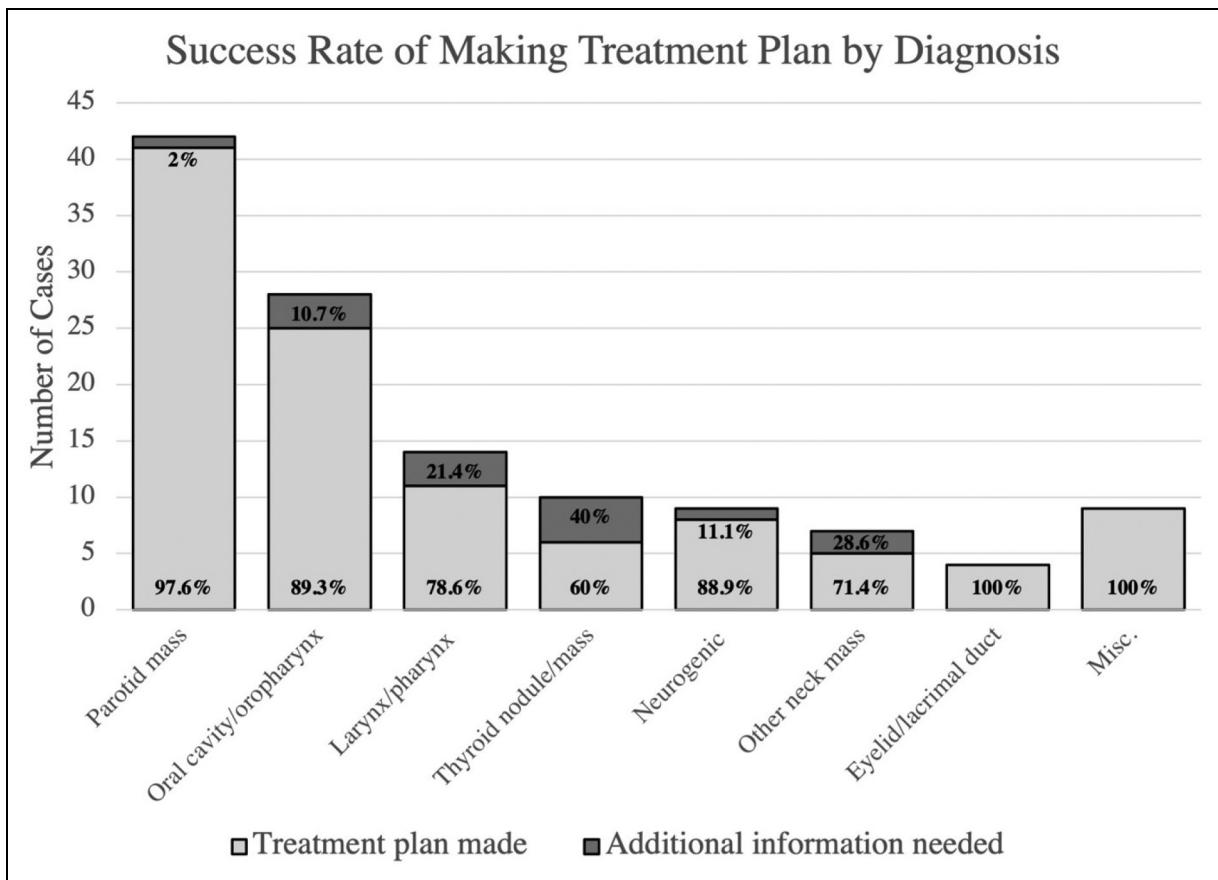


Figure 4. Success rate of making treatment plan via video visit by diagnosis category.

Table 2. Crude univariate and multivariate odds ratios for successful treatment plan made via video visit.

Variable	Crude OR (95% CI)	p (univariable)	Adjusted OR (95% CI)	p (multivariable)
Sex		1.00†		0.29†
Male	ref	-	ref	-
Female	1.00 (0.3, 3.0)	-	0.45 (0.1, 2.0)	-
Age (per unit)	0.96 (0.9, 1.0)	0.0632†	0.96 (0.9, 1.0)	0.1126†
Diagnosis		0.0264†*		0.0237†*
Parotid mass	ref	-	ref	-
Oral cavity/oropharynx	0.21 (0.0, 2.2)	0.1920	0.18 (0.0, 3.2)	0.2394
Larynx/pharynx	0.09 (0.0, 0.1)	0.0496*	0.07 (0.0, 1.3)	0.0766
Thyroid nodule/mass	0.40 (0.0, 0.4)	0.0067*	0.19 (0.0, 0.5)	0.0175*
Neurogenic	0.21 (0.0, 3.6)	0.2801	0.28 (0.0, 6.0)	0.4123
Other neck mass	0.06 (0.0, 0.8)	0.0365*	0.04 (0.0, 0.9)	0.0429*
Eyelid/lacrimal duct	N/A	-	N/A	-
Misc.	N/A	-	N/A	-
Number of diagnostic tests per patient [‡]		0.68†	-	-
0	0.64 (0.2, 2.7)	0.5424	-	-
1	1.04 (0.3, 4.2)	0.9484	-	-
2	ref	-	-	-
3	2.43 (0.3, 22.4)	0.4325	-	-
4	N/A	-	-	-
Type of diagnostic test ^{§,‡}		-	-	-
MRI	2.94 (0.6, 14.1)	0.1774	-	-
CT	1.63 (0.5, 5.4)	0.4260	-	-
PET	1.47 (0.3, 7.7)	0.6471	-	-
Biopsy	1.21 (0.3, 4.5)	0.7690	-	-
Ultrasound	0.80 (0.2, 3.4)	0.7588	-	-

Sample size limited adjusted regression model analysis involving the number and type of diagnostic tests available. Variable category p-values included where applicable. MRI: magnetic resonance imaging; CT: computerized tomography; PET: positron emission tomography.

*Indicates p-value of statistical significance at $\alpha=0.05$.

†Indicates variable category p-values, not level-specific.

‡Sample size limited meaningful adjusted regression model analysis for these categories.

§Reference is the absence of a diagnostic test.

manifestations of other head and neck tumors, e.g. nasopharyngeal carcinoma. Following excision and pending final pathology, this possibility should be considered and may warrant subsequent in-person evaluation for a thorough inspection of the ear, scalp, face, and pharyngoscopy.⁴⁴

Visit indications less amenable to evaluation by video visit

Physicians were statistically less likely to make a treatment plan for patients presenting with a thyroid nodule ($p=0.018$) or other neck mass ($p=0.040$). This remained significant even after adjusting for possible confounders. This may be due to thyroid nodules requiring ultrasound and biopsy for definitive recommendations on excision versus observation as defined by the American Thyroid Association guidelines and Bethesda criteria.⁴⁵⁻⁴⁷ In addition, the inability of the physician to perform clinically accurate palpation for mobility, firmness, and fluctuance of these masses further limits the assessment of the degree of suspiciousness of the thyroid lesion. Unlike parotid tumors, which are almost solely managed by otorhinolaryngologists, thyroid pathologies often

require multi-specialty care often engaging consultation from endocrinologists. As a result, thyroid pathologies are less conducive to definitive decision-making following one video visit. It remains to be seen if virtual platform modifications such as multi-disciplinary video visits could result in a better success.

Patients with human papillomavirus-positive tonsillar neoplasms also required more work-up before a definitive plan could be offered. This may reflect the multi-disciplinary care required for these tumors, often requiring input from radiation and medical oncology.⁴⁸ While this population stands out from its counterparts in the oral cavity and oropharynx by often consisting of healthy patients with little to no comorbidities, this population also generally presents with nodal positive disease justifying its multi-specialty treatment approach.⁴⁹ In addition, evaluation for oropharyngeal cancers includes an intraoral examination and intranasal scoping for diagnosis, limiting the utility of video evaluation alone.

Utility of diagnostic tests

At the time of the video visit, the most common diagnostic tests available to physicians were CT scans followed by

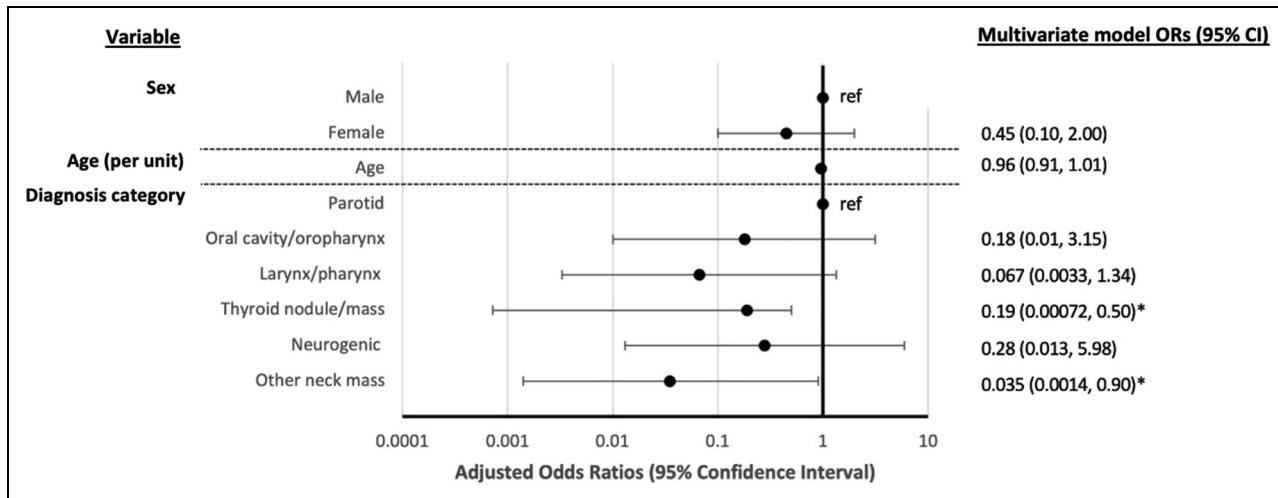


Figure 5. Forest plot depicting adjusted multivariate model odds ratios and 95% confidence intervals for regression analysis by definitive treatment plan made via video visit. Ref indicates reference group for variable. *indicates p -value of statistical significance at $\alpha = 0.05$.

biopsy reports and MRI. An adjusted multivariate regression model demonstrated that the presence of any specific work-up had no significant effect on whether a treatment plan could be made. In addition, the number of diagnostic tests was not a significant predictor of the success of a video visit. This would suggest that neither diagnostic test type nor number is particularly essential in facilitating a successful video visit for all head and neck indications overall. However, this is counterintuitive, as head and neck represents a subspecialty known to have plans largely derived from objective imaging and work-up. As with traditional in-person visits, the ability to diagnose and formulate a definitive plan for different indications may vary according to the degree of reliance on imaging for each indication. For example, imaging findings rarely change management for parotid lesions, usually operative in nature. However, the characteristics of a thyroid lesion (e.g. rate of growth, presence of extracapsular extension, etc.) determined via examination or biopsy influence a physician for recommending resection, radiation therapy, or conservative management including observation. Our sample size may have limited more statistically meaningful regression analysis for diagnostic tests by visit indication. Further work to define the nature and level of work-up needed for varying indications in order for video visits to have utility in treatment planning would be of interest.

Geographic catchment

The geographic spread of patients seen was largely national with high densities of patients originating from intrastate or neighboring Midwest states (Figure 3). This pattern may reflect relationships between our institution and local referring centers. Notably, the increased percentage of out-of-region patients seen with video visits may also reflect increased

accessibility and preference for the convenience and cost-savings of telehealth compared to the in-person initial evaluation, especially for patients seeking second opinions.

In a systematic review by Gunter et al.,⁵⁰ both significant cost savings and patient time were reported using telemedicine. Patients saved on average between 79.6 and 367.2 “round-trip” miles and a total of 77.5–317 min in travel time. These values translated into direct financial savings for patients, ranging from \$36 to \$357.^{51–58} In addition, Americans, on average, spend 123 min per visit between travel time to medical facilities, waiting room time, and face-to-face time with the physician—of this, only 20.5 min are spent in face-to-face time.⁵⁹ Telemedicine has demonstrated to be an effective way to reduce non-clinical time—waiting at the start and end of appointments and transferring between rooms.⁶⁰ These findings can be extrapolated to our cohort, as patients living more than 250 miles away comprised roughly two-thirds of the cohort, with the distribution of distances being right-skewed likely given 9.8% ($n=12$) international patients (Table 1). Though calculating cost and time-savings is outside this study’s scope, it is sufficient to say virtual appointments can provide benefits to patients nationwide and may be offered as the entry care-point to a tertiary care institution.

Limitations

Telemedicine is an opportunity to improve the access and quality of head and neck care, but it requires health care teams to adapt to different processes. Successful virtual visits often hinge on sufficient preparation preceding the visit including gathering medical records, confirming telemedicine appointments, and helping patients navigate technology.⁶¹ We especially acknowledge the risk of generalizability bias that can occur from data originating from tertiary care centers.⁶² Our study population primarily consists of patients

who have likely already seen a specialist, received a preliminary diagnosis, and/or undergone imaging and laboratory tests, having more clinical information available to conduct a video visit than compared to patients presenting to general otolaryngologists elsewhere with new concerns.

Other limitations of our study include that it is single-center in nature, retrospective, and does not account for patients lost to follow-up. Lastly, small sample sizes within indication categories mean the cohort may have been underpowered to detect any significant impact that the number or type of diagnostic tests have on the ability to successfully formulate a treatment plan. Expanding the study period and/or incorporating other virtual visit modalities (e.g. telephone visits) and assessing the persistence of our results may be of interest in follow-up studies.

Future directions

Future studies should investigate whether the outcomes in our study are generalizable to other tertiary care institutions and examine other standard outcomes used to assess the success of in-person visits including patient and physician experience, reimbursement rate, and cost-effectiveness. Further exploration into how the diversity of treatment options and complexity of decision-making by subsites may influence the suitability of telemedicine evaluations would also be of value. It may guide patients in outlining what imaging, labs, etc. should be sought locally in order to maximize the utility of a video consultation with tertiary care physicians. It would be interesting too to explore how the utility of pre-assessment varies between prior visits with generalists versus specialists.

Conclusion

Many factors contribute to the success of a video visit in head and neck surgery. Our data suggest that the visit indication and underlying pathology at a specific head and neck subsite have the largest effect on whether a treatment plan can successfully be made. Parotid neoplasms appear particularly amenable to telemedicine, whereas thyroid and tonsillar neoplasms often require additional workup. We hope to encourage further investigation into the feasibility of incorporating video visits with standard head and neck practices, especially at other tertiary care centers sharing similar patient characteristics.

Acknowledgements

The authors would like to thank Thomas J. O'Byrne, MAS for statistics consultations throughout the project.

ORCID iDs

Katherine Z Xie  <https://orcid.org/0000-0003-0007-5136>
Luis A Antezana  <https://orcid.org/0000-0003-1575-3593>

Previous Presentations

The findings of this research were presented as a poster at the American Academy of Otolaryngology-Head and Neck Surgery Foundation (AAO-HNSF) 2021 Annual Meeting held in Los Angeles, California, from 3 to 6 October 2021.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

References

1. Sclafani AP, Heneghan C, Ginsburg J, et al. Teleconsultation in otolaryngology: live versus store and forward. *Otolaryngol Head Neck Surg* 1999; 120: 62–72.
2. Rimmer RA, Christopher V, Falck A, et al. Telemedicine in otolaryngology outpatient setting—single center head and neck surgery experience. *Laryngoscope* 2018; 128: 2072–2075. doi:10.1002/lary.27123
3. Gonzalez JN, Axiotakis LG, Yu VX, et al. Practice of telehealth in otolaryngology: a scoping review in the era of COVID-19. *Otolaryngol Head Neck Surg* 2021; 166: 417–424.
4. Ning AY, Cabrera CI and D'Anza B. Telemedicine in otolaryngology: a systematic review of image quality, diagnostic concordance, and patient and provider satisfaction. *Ann Otol Rhinol Laryngol* 2021; 130: 195–204.
5. Garritano FG and Goldenberg D. Successful telemedicine programs in otolaryngology. *Otolaryngol Clin North Am* 2011; 44: 1259–1274. doi:10.1016/j.otc.2011.08.003
6. Wu CJ, Wu SY, Chen PC, et al. An innovative smartphone-based otorhinoendoscope and its application in mobile health and teleotolaryngology. *J Med Internet Res* 2014; 16: 1–11.
7. Biagio L, Swanepoel DW, Adeyemo A, et al. Asynchronous video-otoscopy with a telehealth facilitator. *Telemed e-Health* 2013; 19: 252–258. doi:10.1089/tmj.2012.0161
8. Biagio L, Swanepoel DW, Laurent C, et al. Video-otoscopy recordings for diagnosis of childhood ear disease using telehealth at primary health care level. *J Telemed Telecare* 2014; 20: 300–306. doi:10.1177/1357633X14541038
9. Lundberg T, Westman G, Hellstrom S, et al. Digital imaging and telemedicine as a tool for studying inflammatory conditions in the middle ear—evaluation of image quality and agreement between examiners. *Int J Pediatr Otorhinolaryngol* 2008; 72: 73–79. doi:10.1016/j.ijporl.2007.09.015
10. Mba MN, Eikelboom RH, Atlas MD, et al. Evaluation of video-otoscopes suitable for tele-otology. *Telemed J E Health* 2003; 9: 325–330.
11. Heneghan C, Sclafani AP, Stern J, et al. Telemedicine applications in otolaryngology. *IEEE Eng Med Biol Mag* 1999; 18: 53–62. doi:10.1109/51.775489
12. Furukawa M, Furukawa MK, Mizojiri G, et al. Telemedicine in laryngology. *Telemed J* 1998; 4: 329–333.

13. Haegen TW, Cupp CC and Hunsaker DH. Teleotolaryngology: a retrospective review at a military tertiary treatment facility. *Otolaryngol Head Neck Surg* 2004; 130: 511–518. doi:10.1016/j.otohns.2004.01.010
14. McCool RR and Davies L. Where does telemedicine fit into otolaryngology? An assessment of telemedicine eligibility among otolaryngology diagnoses. *Otolaryngol Head Neck Surg* 2018; 158: 641–644.
15. Keesara S, Jonas A and Schulman K. COVID-19 and health care's digital revolution. *N Engl J Med* 2020; 382: e82. doi:10.1056/NEJMp2005835
16. Mann DM, Chen J, Chunara R, et al. COVID-19 transforms health care through telemedicine: evidence from the field. *J Am Med Inform Assoc* 2020; 27: 1132–1135.
17. Zhao C, Viana A, Wang Y, et al. Otolaryngology during COVID-19: preventive care and precautionary measures. *Am J Otolaryngol* 2020; 41: 102508.
18. Karim SSA and Karim QA. Omicron SARS-CoV-2 variant: a new chapter in the COVID-19 pandemic. *The Lancet [Internet]* 2021 [cited 2022 Jan 15]; 398: 2126–2128. Available from: <http://www.thelancet.com/article/S0140673621027586/fulltext> (accessed 31 January 2022).
19. Huang VW, Imam SA and Nguyen SA. Telehealth in the times of SARS-CoV-2 infection for the otolaryngologist. *World J Otorhinolaryngol Head Neck Surg* 2020; 6: S49–S53.
20. Vukkadala N, Qian ZJ, Holsinger FC, et al. COVID-19 and the otolaryngologist: preliminary evidence-based review. *Laryngoscope [Internet]* 2020 [cited 2022 Jan 15]; 130: 2537–2543. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1002/lary.28672>
21. Snoswell CL, Stringer H, Taylor ML, et al. An overview of the effect of telehealth on mortality: a systematic review of meta-analyses. *J Telemed Telecare [Internet]* 2021; 1–10. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/34184578>. [cited 2022 Apr 12];1357633X211023700.
22. Snoswell CL, Chelberg G, de Guzman KR, et al. The clinical effectiveness of telehealth: a systematic review of meta-analyses from 2010 to 2019. *J Telemed Telecare [Internet]* 2021; 1–16. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/34184580>. [cited 2022 Apr 12];1357633X211022907.
23. Historical Population Density Data. [Internet]. [cited 2021 Aug 23]. Available from: <https://www.census.gov/data/tables/time-series/dec/density-data-text.html>. 1910–2020.
24. Smith AC, Thomas E, Snoswell CL, et al. Telehealth for global emergencies: implications for coronavirus disease 2019 (COVID-19). *J Telemed Telecare [Internet]* 2020 [cited 2022 Apr 12]; 26: 309–313. Available from: <https://journals.sagepub.com/doi/full/10.1177/1357633X20916567>
25. Thomas EE, Haydon HM, Mehrotra A, et al. Building on the momentum: sustaining telehealth beyond COVID-19. *J Telemed Telecare [Internet]* 2020; 28: 301–308. Available from: <https://journals.sagepub.com/doi/full/10.1177/1357633X20960638>. [cited 2022 Apr 12].
26. Moreland A. Timing of State and Territorial COVID-19 Stay-at-Home Orders and Changes in Population Movement — United States, March 1–May 31, 2020. 69, MMWR. Morbidity and Mortality Weekly Report. Centers for Disease Control MMWR Office 2020.
27. Bryson PC, Benninger MS, Band J, et al. Telemedicine in laryngology: remote evaluation of voice disorders-setup and initial experience. *Laryngoscope* 2018; 128: 941–943. doi:10.1002/lary.26975
28. Hoffman DA. Increasing access to care: telehealth during COVID-19. *J Law Biosci* 2020; 7: 1–15. doi:10.1093/jlb/lssaa043
29. Riley PE, Fischer JL, Nagy RE, et al. Patient and provider satisfaction with telemedicine in otolaryngology. *OTO Open* 2021; 5: 1–9. doi:10.1177/2473974X20981838
30. Telehealth Patient Satisfaction Surges During Pandemic but Barriers to Access Persist, J.D. Power Finds | Business Wire [Internet]. [cited 2021 Aug 21]. Available from: <https://www.businesswire.com/news/home/20201001005094/en/Telehealth-Patient-Satisfaction-Surges-During-Pandemic-but-Barriers-to-Access-Persist-J.D.-Power-Finds>
31. Itamura K, Rimell FL, Illing EA, et al. Assessment of patient experiences in otolaryngology virtual visits during the COVID-19 pandemic. *OTO Open* 2020; 4: 1–4. doi:10.1177/2473974X20933573
32. Stalfors J, Holm-Sjögren L, Schwieler Å, et al. Satisfaction with telemedicine presentation at a multidisciplinary tumour meeting among patients with head and neck cancer. *J Telemed Telecare* 2003; 9: 150–155.
33. Stalfors J, Edström S, Bjork-Eriksson T, et al. Accuracy of tele-oncology compared with face-to-face consultation in head and neck cancer case conferences. *J Telemed Telecare* 2001; 7: 338–343. doi:10.1258/1357633011936976
34. Wall LR, Ward EC, Cartmill B, et al. Examining user perceptions of SwallowIT: a pilot study of a new telepractice application for delivering intensive swallowing therapy to head and neck cancer patients. *J Telemed Telecare* 2017; 23: 53–59.
35. Burns CL, Ward EC, Hill AJ, et al. A pilot trial of a speech pathology telehealth service for head and neck cancer patients. *J Telemed Telecare* 2012; 18: 443–446. doi:10.1258/jtt.2012.gth104
36. Head BA, Keeney C, Studts JL, et al. Feasibility and acceptance of a telehealth intervention to promote symptom management during treatment for head and neck cancer. *J Support Oncol* 2011; 9: e1–e11.
37. Mishra A, Kapoor L and Mishra SK. Post-operative care through tele-follow up visits in patients undergoing thyroidectomy and parathyroidectomy in a resource-constrained environment. *J Telemed Telecare* 2009; 15: 73–76. doi:10.1258/jtt.2008.080808
38. Van Den Brink JL, Moorman PW, De Boer MF, et al. Involving the patient: a prospective study on use, appreciation and effectiveness of an information system in head and neck cancer care. *Int J Med Inf* 2005; 74: 839–849. doi:10.1016/j.ijmedinf.2005.03.021
39. Kohlert S, Murphy P, Tse D, et al. Improving access to otolaryngology-head and neck surgery expert advice through eConsultations. *Laryngoscope* 2018; 128: 350–355. doi:10.1002/lary.26677
40. Sclafani AP, Shomorony A, Stewart MG, et al. Telemedicine lessons learned during the COVID-19 pandemic: the augmented outpatient otolaryngology teleconsultation. *Am J Otolaryngol* 2021; 42: 102960.
41. Shehan JN, Agarwal P, O'Neil Danis D, et al. Effects of COVID-19 on telemedicine practice patterns in outpatient otolaryngology. *Am J Otolaryngol* 2021; 42: 103044.

42. Stalfors J, Björholt I and Westin T. A cost analysis of participation via personal attendance versus telemedicine at a head and neck oncology multidisciplinary team meeting. *J Telemed Telecare* 2005; 11: 205–210. doi:10.1258/1357633054068892
43. Alvi S, Chudek D and Limaiem F. Parotid Cancer. In: *StatPearls [Internet]*. Treasure Island, FL: StatPearls Publishing 2022. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK538340/>
44. Yeung K-W, Chiang P-T, Chang C-Y, et al. A parotid gland mass as an initial metastatic manifestation of nasopharyngeal carcinoma. *J Cancer Res Pract* 2018; 5: 123–126: 1–133.
45. Haugen BR, Alexander EK, Bible KC, et al. American thyroid association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer: the American thyroid association guidelines task force on thyroid nodules and differentiated thyroid cancer. *Thyroid* 2015, 2016; 26.
46. Cibas ES and Ali SZ. The 2017 Bethesda system for reporting thyroid cytopathology. *Thyroid* 2017; 27: 1341–1345. doi:10.1089/thy.2017.0500
47. Alshaikh S, Harb Z, Aljufairi E, et al. Classification of thyroid fine-needle aspiration cytology into Bethesda categories: an institutional experience and review of the literature. *Cytojournal* 2018; 15:29531571. doi:10.4103/cytojournal.cytojournal_32_17
48. Moore EJ, Olsen KD and Kasperbauer JL. Transoral robotic surgery for oropharyngeal squamous cell carcinoma: a prospective study of feasibility and functional outcomes. *Laryngoscope* 2009; 119: 2156–2164. doi:10.1002/lary.20647
49. Chen SY, Sinha P, Last A, et al. Outcomes of patients with single-node metastasis of human papillomavirus-related oropharyngeal cancer treated with transoral surgery. *JAMA Otolaryngol Head Neck Surg* 2021; 147: 16–22.
50. Gunter RL, Chouinard S, Fernandes-Taylor S, et al. Current use of telemedicine for post-discharge surgical care: a systematic review. *J Am Coll Surg* 2016; 222: 915–927. doi:10.1016/j.jamcollsurg.2016.01.062
51. Hwa K and Wren SM. Telehealth follow-up in lieu of post-operative clinic visit for ambulatory surgery: results of a pilot program. *JAMA Surg* 2013; 148: 823–827.
52. Canon S, Sher A, Patel A, et al. A pilot study of telemedicine for post-operative urological care in children. *J Telemed Telecare* 2014; 20: 427–430. doi:10.1177/1357633X14555610
53. Costa MA, Yao CA, Justin Gillenwater T, et al. Telemedicine in cleft care: reliability and predictability in regional and international practice settings. *J Craniofac Surg* 2015; 26: 1116–1120. doi:10.1097/SCS.00000000000001560
54. Eisenberg D, Hwa K and Wren SM. Telephone follow-up by a midlevel provider after laparoscopic inguinal hernia repair instead of face-to-face clinic visit. *J Soc Laparoendosc Surgeons* 2015; 19: 1–4.
55. Sathyakumar V, Apfeld JC, Obremskey WT, et al. Prospective randomized controlled trial using telemedicine for follow-ups in an orthopedic trauma population: a pilot study. *J Orthop Trauma* 2015; 29: e139–145.
56. Urquhart AC, Antoniotti NM and Berg RL. Telemedicine-An efficient and cost-effective approach in parathyroid surgery. *Laryngoscope* 2011; 121: 1422–1425. doi:10.1002/lary.21812
57. Viers BR, Lightner DJ, Rivera ME, et al. Efficiency, satisfaction, and costs for remote video visits following radical prostatectomy: a randomized controlled trial. *Eur Urol* 2015; 68: 729–735. doi:10.1016/j.eururo.2015.04.002
58. Stypulkowski K, Uppaluri S and Waisbren S. Telemedicine for postoperative visits at the Minneapolis VA medical center. Results of a needs assessment study. *Minn Med* 2015; 98: 34–36.
59. Ray KN, Chari A V, Engberg J, et al. Disparities in time spent seeking medical care in the United States. *JAMA Intern Med* 2015; 175: 1983–1986.
60. Ellimootttil C and Boxer RJ. Bringing surgical care to the home through video visits. *JAMA Surg* 2018; 153: 177–178. doi:10.1001/jamasurg.2017.4926
61. Redleaf MI, Welling DB and Wackym PA. Expanded use of teleservices in otology and neurotology in response to the COVID-19 (SARS-cov-2) pandemic. *Laryngoscope Investig Otolaryngol* 2020; 5: 950–953.
62. Layde PM, Broste SK, Desbiens N, et al. Generalizability of clinical studies conducted at tertiary care medical centers: a population-based analysis. *J Clin Epidemiol* 1996; 49. doi:10.1016/0895-4356(96)00006-6